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SOURCES OF WASTES FROM KRAFT PULPING AND THEORETICAL POSSIBILITIES OF REUSE OF CONDENSATES

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SOURCES OF WASTES FROM KRAFT PULPING

AND

THEORETICAL POSSIBILITIES OF REUSE OF CONDENSATES

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(Presented at Third Southern Municipal and Industrial Waste Conference, North Carolina State College, Raleigh, N. C.)

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have been conducted

The Industrial Wastes Section of the Robert A. Taft Sanitary Engineering Center has conducted studies of liquid wastes at several kraft pulp and paper mills during the past few years (1). The sources of wastes in the process and the in-plant control practices observed in these studies are outlined in this paper. In addition some ideas having theoretical possibilities for further reducing waste loads are presented. Undoubtedly, in the history of the search for pollution control measures, many of the capable men of the industry have considered and perhaps tested similar methods. A useful purpose is served by enumerating them and making the information available in the literature for others to consider. Perhaps those with knowledge of the limitations of these proposals will be aroused to record their experience, for there remains the hope that, though found impractical in the past, new developments in equipment or refinements of method may make practical some of these ideas.

As is true of many complicated industrial processes, dealing with the waste problem of kraft pulp manufacture requires knowledge of the manufacturing process and sources of wastes. A general knowledge of the process is presumed.

This discussion is concerned with the wastes from the pulp manufacturing process, ending with the pulp washing system. The wastes are discussed in sequence of their occurrence as the raw material is processed.

A. Wastes from Log Fluming and Haul-up Sprays

Most mills do not use log flumes; however, two systems of log fluming have been observed during our surveys. In one system the logs were floated in a long narrow channel, which was in effect a tank, and were moved along by flight type chain conveyors operating beneath the water surface. The chain conveyor on its return trip scraped sediment from the bottom and deposited it in a sump at one end from which it was withdrawn and used for fill. The flume water was drawn down once each shift in order to inspect the conveyor, to remove floating bark, and to maintain cleaner water. Make-up water used was waste paper machine white water. The second system transported the logs by means of a large volume of rapidly flowing water. This water was waste water from the mill.

A remaining component of this waste is spray water used on the log haul-ups, both those conveying barked and those conveying debarked logs. Such sprays are apparently universally used.

Flume and spray water is quite minor in terms of the quantity of BOD produced, amounting to less than 0.2 pounds per ton of production (5-day, 20° C.). Its suspended solids content is significant, however, being 5 to 7 pounds per ton of product. The pieces of floating and suspended bark make the waste particularly significant as the floating material or sludge beds which they produce are unsightly and aesthetically objectionable.

The obvious and most extreme waste reduction measure for this waste would be to eliminate use of water in the log handling operation. Dry handling offers an additional advantage in the utilization of bark for boiler fuel because the bark remains dry. Heat lost in evaporating the water absorbed from the fluming or spraying operation would be available for steam generation. One of the major reasons for water sprays on log or wood handling equipment is to reduce excessive wear on this equipment by rinsing out the sand and other abrasive materials from the moving metal parts. Some newer installations use rubber belts, but these also have limitations and are high in first cost. There also is need of removing loose bark and gravel or grit from logs before they enter the chipper to protect the chipper blades and to prevent the material from entering the digesters. Spray water on well debarked logs probably would not contribute significant pollution, although air jet cleaning may be a feasible alternative.

Short of elimination, separate treatment of these wastes would be advantageous. The suspended solids are considered to be much more readily removed than the fiber of paper mill wastes because of higher settling rates. Fine screening would undoubtedly greatly relieve the suspended bark problem; 50 mesh or finer screens may be practical with small volumes. Since damage to the product at this point through the use of contaminated water seems unlikely, a recirculation system for this water might be practical. In fact in some mills where logs are barked by hydraulic jets, the water is reused after passing through a screen which removes the coarse material. By reuse the discharge is very much reduced. A closed system might be practical where the water would be settled, floating material skimmed off, and the effluent reused in the sprays and flume.

Periodic draining of log flumes of the tank type accentuates the waste problem by creating a slug of pollution. Uniform discharge of the waste water would be an effective measure in reducing pollution effects.

B. Wastes Associated with Pulp Digestion

The wastes associated with pulp digesters are leaks and spills in the liquor and pulp handling area, condensate from the turpentine separator, condensing water used in the turpentine condenser, and condensate from the blow tank vapors.

Leaks and spills in the digester area are connected with the charging of cooking liquor, repair of plugged or malfunctioning valves, cleaning out of digesters or piping, and valve leaks. Losses in this area are recoverable; the use of a sump to reclaim digester room leaks and spills is a profitable practice. The liquor can be returned to the weak black liquor and the solids to the chips or pulp washing system. To accomplish this the area is drained to a sump from which the liquids and solids are returned to appropriate points in the system. Use of water for wash-ups would necessarily have to be restricted or prohibited. The use of steam for clean-ups may be a helpful substitute for water wash-ups, preventing dilution of the waste liquor.

Indirect condensers are used in the turpentine recovery system. Therefore the condensing water is uncontaminated, the increase in temperature being the only objectionable feature to direct discharge. If this heated water cannot be used at other places in the process it could be recirculated through cooling towers. With such a recirculated system optimum possibilities for corrosion control measures are available. If effluent waste treatment is carried out it might be advantageous to discharge such uncontaminated wastes as this separately. The volume of this waste is small when compared to other condensing waters used in the plant.

Other wastes from the digester operations, namely condensates from the turpentine separator and blow tank vapor condensing systems, are discussed in a subsequent section dealing with the reuse of condensates.

C. Wastes Associated with Pulp Washing

Major factors in the reduction of wastes from pulp washing have been the development of countercurrent vacuum washing systems and press washing systems. Actually it is the closing of these systems to the point where all the wash water is sent to the evaporators which is important in waste reduction. Countercurrent rotary filter washing systems still may have a large waste of dilute wash water if an excessive amount of wash water is used or if filter capacity is insufficient. Closing the system has its limitations even as a waste control measure in that the pulp must be washed clean enough to prevent excessive amounts of soluble matter being carried to the pulp screening and paper making operations. A large percentage of any readily soluble matter carried into the pulp refining or paper making operations will appear in wastes from these operations. Obviously very clean pulp could be produced in a closed countercurrent system if unlimited dilution of the black liquor were permissible. The economics are complicated — cost of washing, cost of evaporating, value of recovered chemicals, and cost of waste treatment are all involved.

Adequate capacity of rotary filters is an important factor. The necessary capacity is indicated by operating data from the mills studied. Thus one mill using a closed 4-stage rotary filter washing system, provided about 140 square feet of filter per ton of pulp production per hour.

Weak black liquor was obtained at 15 to 17 percent total solids and amounted to 1750 gallons per ton of air dry pulp. Washed pulp contained an average of 51 pounds of residual salt cake per ton of air dry pulp. The BOD of wastes from pulp screening and paper making amounted to about 8.3 pounds per ton of pulp. At the opposite extreme, one mill provided a rotary filter washing system, not closed, with only 28 square feet of filter area per ton of pulp production per hour. Pulp washing wastes at this mill contained BOD estimated in excess of 175 pounds per ton of pulp.

Black liquor always foams to a certain extent; foaming in brown stock washers, filtrate receiving tanks, and in black liquor handling often results in considerable losses to the sewer. Black liquor foams much more at low concentrations. The use of green wood increases the foaming properties of black liquor, particularly when producing a hard-cooked stock. Conversely, the use of dry wood or the production of a soft-cooked stock, especially when an excess of alkali is used in the cooking operation, produces a black liquor of less foaming characteristics (2).

Foaming in brown stock washers may be avoided by correct entrance conditions, stock velocity, and clearance between the vat and the cylinder. In some cases the vacuum pump may aggravate foaming conditions. In any case, the liquor passing down the barometric leg carries with it a large amount of entrained air. It is important to remove this before the liquor is reused. This is accomplished by discharging the liquor into large tanks, the large surface of which allows the foam bubbles to break and the entrained air to escape. The suction of the pump removing the liquor for reuse should be located close to the bottom of the tank, in which section the liquor is relatively free from foam, and as far from the barometric leg as possible. Vacuum pumps have been eliminated from some systems in order to reduce foam troubles.

Too high a vacuum for the liquor temperature will result in badly foaming liquor. Wash water hotter than 170° F. may also cause foaming trouble.

In a press washing system, which is a relatively new development for pulp washing, foam difficulties caused by air entrainment are eliminated by maintaining the system at high pressures. The pressure maintenance features may have application to rotary filter systems.

Once foam is produced it has to be disposed of either by breaking the bubbles mechanically and returning the liquor to the system or by flushing the foam to sewers with water sprays. Mechanical foam breakers and foam towers permit recovery of the material in the foam in an undiluted state which makes possible its return to the black liquor. The practice of flushing foam to the sewers is, of course, contrary to water pollution control aims.

One mill with a closed washing system and vacuum pumps on the filters had losses to the sewer from foaming of less than one pound of BOD per ton of pulp. Another mill which utilized vacuum pumps and a heavily loaded washing system had an average load from foam flushing of 9 pounds of BOD per ton of pulp.

In summary, pollution from pulp washing operations, including losses from foaming troubles, can be practically eliminated by proper equipment and operation. There are today several equipment layouts in operation which return all liquor to evaporators and produce pulp so well washed that the organic solubles and chemicals are relatively insignificant.

D. Wastes Associated with Chemical Recovery

Wastes from the chemical recovery system, which sometimes are sewered are green liquor dregs, slaker grit drainings, and lime kiln stack gas wash water. The green liquor dregs and slaker grit may be segregated and discharged to lagoons where they drain and dry readily. Lime kiln stack gas wash water may be recirculated. At one mill practicing such recirculation the drawoff from the system is limited to the amount used to form green liquor. The flow pattern of water in this system is as follows: the water is first used for final washing of the lime mud on the filter; then for lime kiln stack gas washing; next for counter-current washing of the lime mud; next for dregs washing; and finally for dissolving smelt.

Evaporators are occasionally cleaned to remove any deposited material interfering with heat transfer. Such cleaning may be done on a weekly schedule or may be done only when necessary after months of operation. One of the mills at which the Center made its waste studies carried out this cleaning operation using high pressure steam. The steam was blown through the tubes and body of the evaporator for a period of about 20 minutes. The steam and material washed from the evaporator constituted a significant pollution load which was discharged to the sewer. At some mills evaporators are cleaned by boiling them out with solutions of white liquor. The liquor solution is subsequently returned to the process. Rinse water washes following such washouts remain as a waste source. For effective waste control, particularly strong wastes from evaporator clean-out might best be disposed of to closed lagoons or at least discharged so that heavy slug loads on the receiving waters are avoided.

Condensates from an evaporator which is not overloaded are water white in appearance though they contain significant concentrations of organic matter. Some operators associate color with pollution and consider a clear white evaporator condensate as harmless, when in fact it contains a high concentration of dissolved organics. Evaporators which are overloaded or which are plagued with foaming difficulties will entrain liquor in the overhead vapors. The condensates produced where heavy entrainment is occurring may contain as much as 20 or more times the normal concentration of organic matter. They may also be highly colored. These condensates are further discussed in the following section.

E. Reuse of Condensates

After application of the in-plant control measures previously discussed the remaining important waste sources are (1) condensates from black liquor evaporators, digester relief, and blow, and (2) the soluble organic matter contained in the washed pulp. Further reductions of the waste load by in-plant control methods are thus indicated as involving (1) elimination of the discharge of condensates, and (2) improving the washing system so that more of the soluble organic material is transferred from the pulp to the weak black liquor. The kraft pulping process includes a means of disposal of waste organic matter (the non-fibrous portion of the wood) by its combustion in the processes for recovery of chemicals. This section deals with the possibilities of reuse of condensates as a waste reduction measure. The objective of reuse of condensates as a water pollution control measure would be return of the organic material they contain to the liquor in the system so that such matter might eventually be destroyed.

All references to quantities of water in this section refer to pounds of water per ton of air dry pulp. The expression "air dry" assumes 10% moisture, thus a ton of air dry pulp is equivalent to 1800 pounds moisture free. In this discussion a sextuple effect evaporator is assumed.

1. Present Practice and Probable Accomplishments

The condensed vapors from the blow tank together with the associated condensing water are now being partially reused in the pulp-washing operations in some mills. Condensates from the black liquor evaporators are also partially reused for this purpose in at least one mill. At one of the mills included in the Public Health Service studies, blow tank vapor condensate was reused for dissolving smelt. The organic material these condensates contained thus became a part of the weak black liquor or was contained in the washed pulp leaving the counter-current washers.

Any soluble material in the reused condensates which remained with the pulp leaving the washing system was probably dissolved in the pulp screening and paper making operations and discharged with their wastes. Perhaps a trace remained with the finished paper. The reused condensate would have to be purged from the pulp leaving the washer by fresh water in order for reuse to be an effective waste reduction measure.

The volatile organic materials returned to the weak black liquor would tend to build up in concentration in the condensates. That portion of the condensates discharged as wastes would probably carry an increased concentration. The amount of volatile organic material

removed from the wastes would only be the portion actually destroyed or removed from the system. Such destruction would occur if the materials reach the recovery furnace or lime kiln.

2. Water Balance in the Kraft Pulping System

Table 1 lists sources and outlets of water in the kraft pulping system. The system considered in this balance begins with the wood chips and white liquor and terminates with the washed pulp mat and smelt. The smelt dissolving, chemical reconstituting and lime burning operations are considered separately. The quantities are not presented as typical or average but as being within the range of practice and occurrence. They are based on values listed in Pulp and Paper Manufacturing modified to obtain a water balance (2). The amount of wash water used in this balance is considerably greater than that used in the newest washing systems where water use is minimized. In the interest of simplicity the quantity of water in any black liquor used to make the digester liquor up to volume before the cook is not listed because such water is recirculated within the system. Cooling water used in condensers is not listed because it may be considered extraneous to the pulping system itself. The direct heated type of digesters are assumed in this balance. The water balance is shown schematically in Figure 1.

The possibilities for reuse of condensates other than for washing pulp are given in Table 2. The first reuse listed is the conversion of condensate into steam for use in the digester. This would require a separate steam generation system to prevent contamination of other steam. The second item, reuse of condensate of fresh steam fed the evaporators, is common practice. This condensate is returned to boiler feed. Steam fed to the evaporators appears as condensate in the steam chest of the first effect and is uncontaminated.

The third reuse, termed water in the white liquor reconstituting system, is actually the sum of a number of uses in a complex system. The system is illustrated in Figure 2. Water intake to the system would be used for a number of purposes in series, as follows: first, for washing the lime mud on the filters; second, for washing the lime kiln stack gases; next, for washing the lime mud in the washing tank; then for washing green liquor dregs; and finally for smelt dissolving. The outlets of water from this multiple use system are listed as follows:

	Lbs. per Ton of Air Dry Pulp
Water in white liquor	6260
Water in lime mud to kiln	819
Water on green liquor dregs	20
Water on causticizer dregs	5
Water evaporated from lime kiln stack gas wash water	-
TOTAL	7104

TABLE 1

WATER BALANCE OF KRAFT PULP MANUFACTURING PROCESS
Quantities in Pounds per Ton of Air Dry Pulp

Sources	Pounds
Water in wood chips	3280
Steam to digesters	3453
Water in white liquor	6260
Wash water	12381
Steam to #1 effect	2175
TOTAL	27,549

Outlets	
Turpentine separator underflow	232
Water in turpentine	-
Blow tank vapor condensate	2030
Condensate in steam chest #1	2175
Condensate in steam chests 2, 3, 4, 5 & 6th effects	8500
Overhead vapors from last effect	2100
Water in concentrated black liquor fed to the recovery furnace	3000
Water in resin and fatty acid soaps	-
Water in pulp leaving the washers	9362
Vapors exhausted over pulp washers	150
	27,549

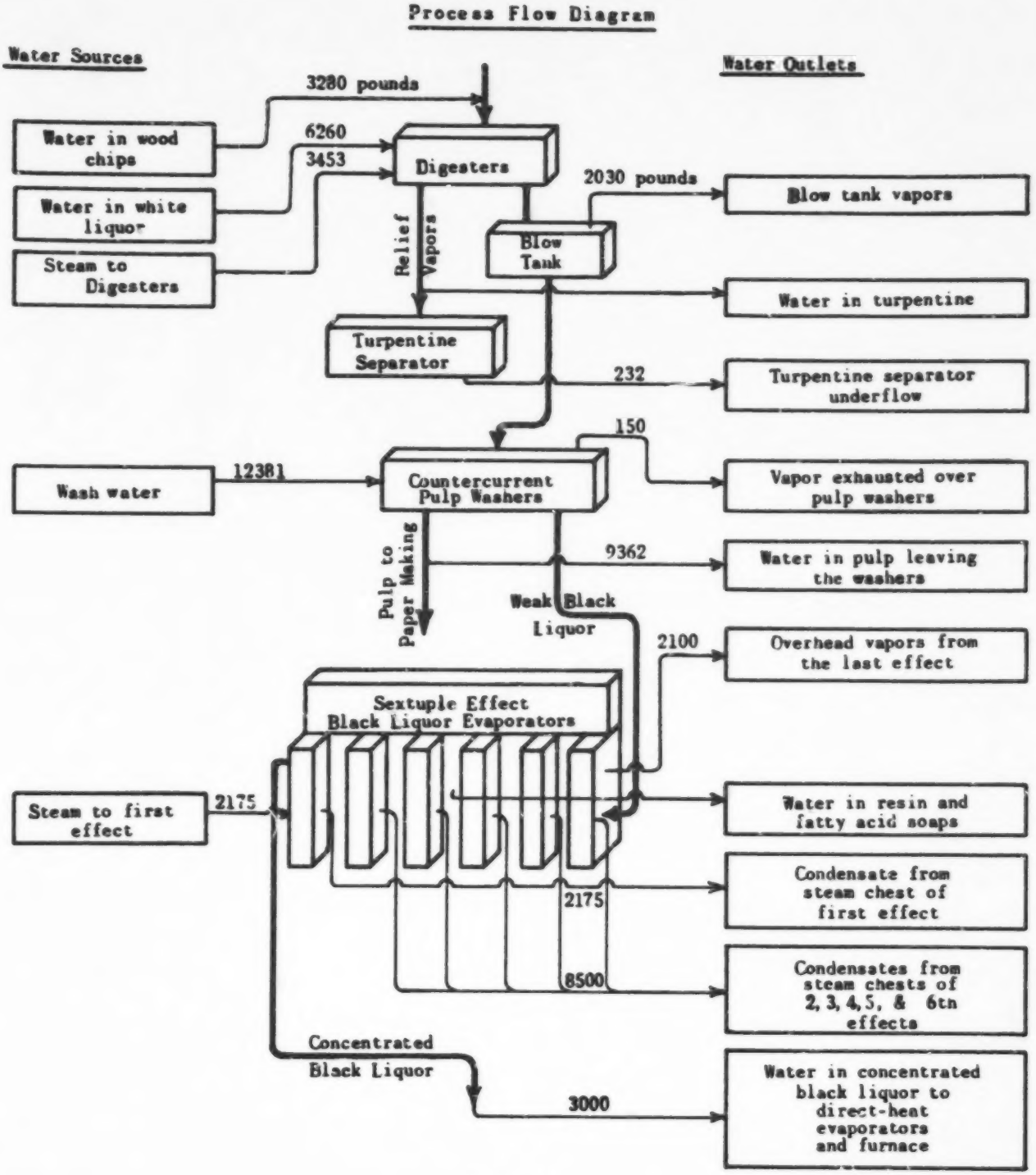

Figure 1

WATER BALANCE OF KRAFT PULP MANUFACTURING PROCESS

Quantities in Pounds per Ton of Air Dry Pulp

As no estimate is available on the amount of water which might be evaporated from the lime kiln stack gas wash water, the possible evaporation of any of this water has been neglected in this discussion.

TABLE 2

CONDENSATE REUSE POSSIBILITIES
OTHER THAN FOR WASHING PULP
Per Ton of Air Dry Pulp.

	Pounds
Steam to digesters	3453
Steam to evaporators	2175
Water in white liquor reconstituting system	7104
TOTAL	12,732

The condensates available for reuse are listed in Table 3. In general practice some of these condensates are mixed with condensing water. Indirect condensers would be necessary if it was desired to obtain these condensates in undiluted form.

TABLE 3

CONDENSATES AVAILABLE FOR REUSE
Per Ton of Air Dry Pulp

	Pounds
Turpentine separator underflow	232
Blow tank vapor condensate	2030
Condensate in steam chest of 1st effect of black liquor evaporators	2175
Condensate in steam chests of 2, 3, 4, 5, & 6th effects of black liquor evaporators	8500
Condensed overhead vapors from 5th effect	2100
TOTAL	15,037

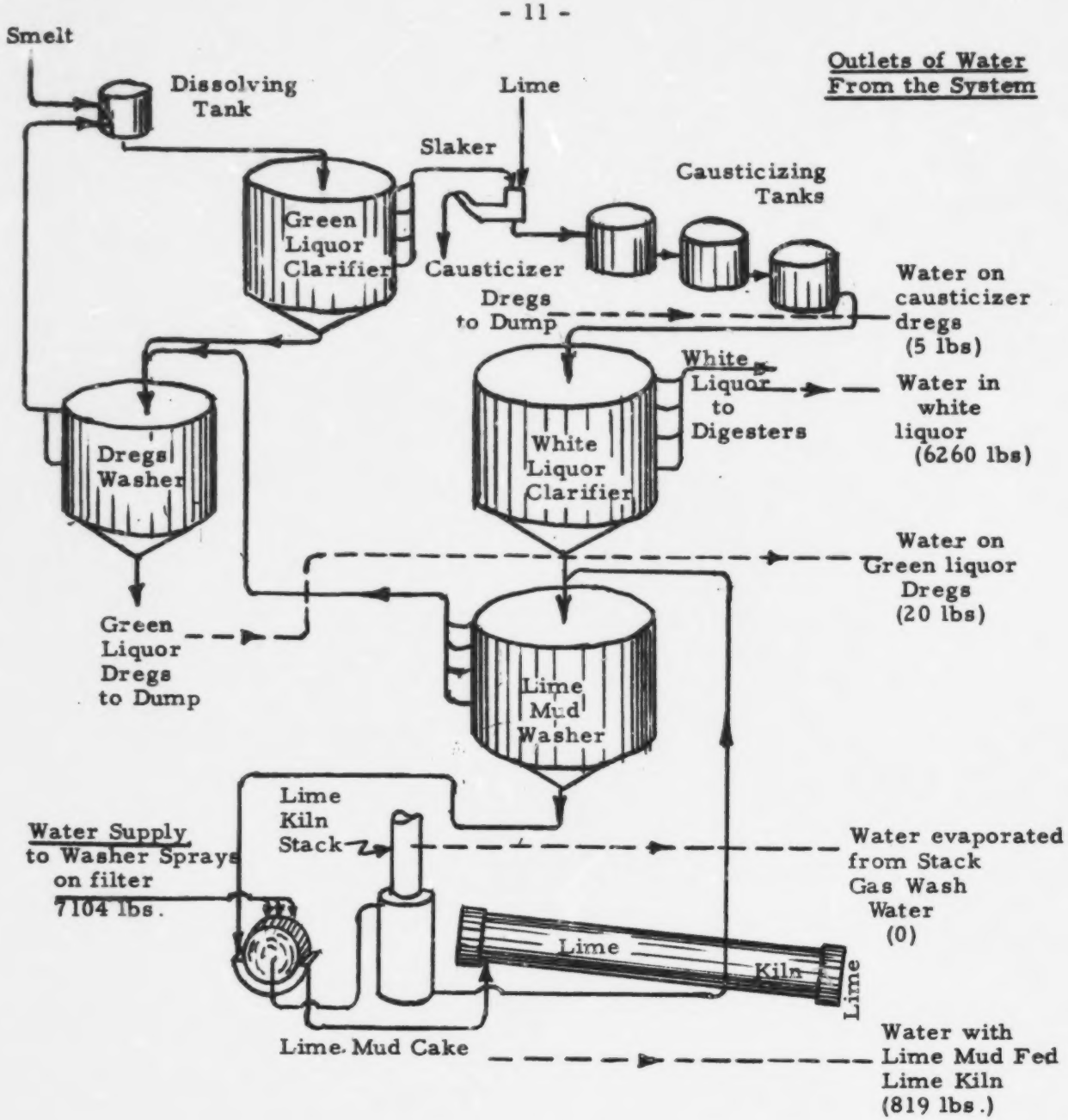

Figure 2

Water Balance in
Chemical Reconstituting System
Quantities in Pounds per Ton
of Air Dry Pulp

The total of Table 3 indicates 15,037 pounds of water available for reuse as compared to the reuses listed in Table 2 of 12,732 pounds. An amount of 2305 pounds (15,037 minus 12,732) remains to be reused for a purpose not listed. The remaining reuse available would be for pulp washing. The above discussion has indicated that a balance could be obtained between condensates available for reuse and reuse possibilities.

Another consideration is comparison of the quantity of water entering the system and outlets of water other than as condensates going to waste. Outlets of water from process are given in Table 4. These outlets are consumptive in so far as elimination of the water from the wastes is concerned. The first two of those listed are outlets to the atmosphere from the kraft pulping system previously considered in the water balance. The next three are outlets of water in the white liquor reconstituting system, i.e., smelt dissolving, lime treatment, and lime burning. As no estimate is available on the amount of water which might be evaporated from the lime kiln stack gas wash water, the possible evaporation of any of this water has been neglected in this discussion.

TABLE 4

WATER OUTLETS NOT TO LIQUID WASTES
Per Ton of Air Dry Pulp

	Pounds
Water in concentrated black liquor fed to the recovery furnace	3000
Vapors exhausted over brown stock washers	150
Water with lime mud to lime kiln	819
Water on green liquor dregs	20
Water on causticizing dregs	5
Water evaporated from lime kiln stack gas wash water	-
Water in pulp leaving the washers	9362
TOTAL	13,356

The amount of water admitted to the system must be equal to or less than the amount in these outlets if liquid wastes are to be eliminated. The moisture content of the wood chips is one water source over which little control is possible. Water in the chips per ton of air dry pulp, as listed in the water balance of Table 1, is 3280 pounds. The water content of the pulp mat leaving the washers would need to be as free of impurities as possible as previously discussed. Therefore, a minimum amount of fresh water necessary for pulp washing would be the quantity of water contained in the pulp mat, 9362 pounds. The total of these two amounts equals 12,642 pounds. The total of the outlets listed in Table 2 equals 13,356 pounds. The difference between these figures is 714 pounds. Thus 714 pounds of additional fresh water could be introduced to the system and a balance obtained between outlets of water other than to the sewers and water intake. Water used for pulp washing would be as follows:

	Pounds
Reused condensate	2305
Fresh water	
(remaining with washed pulp mat)	9362
(entering weak black liquor)	714
TOTAL	12,381

If the condensates are recycled and if use of fresh water for pulp washing is limited to 10,076 pounds (9362 + 714), the system would have no wastes going to the sewers.

3. Proposals for Reuse of Condensates

The most advantageous specific use of each of the condensates might be as outlined below. The condensate in the steam chest of the first effect of the black liquor evaporators is uncontaminated and is commonly returned to boiler feed. It is therefore in effect recirculated from boiler to steam chest and back to boiler. The turpentine separator underflow contains the highest concentration of organic matter of any of the condensates; therefore, it should be reused where the possibility of destroying its organic content is the greatest. The place of reuse best fulfilling this qualification would be the final spray on the lime mud filter. The common type of vacuum drum filter used for washing the lime mud employs several sprays across the filter. The water content of the lime mud leaving the filter is about 819 pounds per ton of air dry pulp and the turpentine separator underflow is about 232 pounds per ton of air dry pulp. The turpentine separator underflow, if used in the last spray, would displace some of the water previously present in the cake

and would remain with the lime cake as it is fed to the kiln. In the kiln the organic matter left in the lime mud would be destroyed.

One of the next most objectionable condensates is the condensed overhead vapors from the sixth effect. If this condensate were used in the wash sprays on the lime mud filter just preceding the final spray wash, discussed above, about 28 percent of this condensate probably would be carried into the lime kiln with the lime mud.

The total amount of water used on the lime mud washer would be the sum of (1) water which is added to the digester in white liquor; (2) water charged to the kiln with the lime mud; (3) water retained on the green liquor dregs; and (4) the water on the causticizing dregs. This equals 7104 pounds of water per ton of air dry pulp. The turpentine separator underflow and the condensed overhead vapors from the 6th effect of the black liquor evaporators amount to 2332 pounds. The remaining 4772 pounds could be obtained from the condensate in the steam chests of the 3, 4, 5, and 6th effects of the black liquor evaporators. This use would consume most of this condensate.

In the water balance for the kraft pulping system previously developed, condensate amounting to 2305 pounds is scheduled for use for pulp washing. The least contaminated condensate available should be used for this purpose. It may be assumed that the condensate from the 2nd effect contains less volatile organics than the condensates from the 3, 4, 5, and 6th effects because the second effect condensate is obtained from the liquor after several preceding evaporation steps. Assuming that equal volumes of condensate are formed in each of the steam chests of the 2, 3, 4, 5, and 6th effects, the condensate from the 2nd effect would equal 1700 pounds. This would supply all but 605 of the 2305 pounds of condensate scheduled for reuse for this purpose. This 605 pounds could be taken from the condensates in the steam chests of the 3, 4, 5, and 6th effects.

Of the 6800 pounds of condensate available in the steam chests of the 3, 4, 5, and 6th effects, 605 pounds would be used for pulp washing and 4772 pounds for washing the lime mud. The 1423 pounds of condensate remaining of the total from the evaporators together with the 2030 pounds of blow tank vapor condensate might be converted to steam and used to supply the digesters.

4. Possible Problems Associated with Reuse of Condensates

One major factor in the feasibility of the reuse of condensates is the extent to which the concentration of volatile organic matter would build up in the system as the proposed recirculation continues. The volatile organic materials returned to the weak black liquor in the reused condensate would either be volatilized again in the evaporator

(to be recycled with the condensate) or would be eliminated from the system by one of the following methods: (1) burning with the concentrated liquor in the chemical recovery furnace; (2) burning with lime cake in the lime kiln; or (3) possibly by volatilizing from the water used to wash the lime kiln stack gases. Negligible amounts of organic matter would be eliminated in the green liquor dregs and the causticizing dregs. Only if the build-up of volatile organic materials can be limited by these methods can the proposed method of waste reduction be successful. Whether an excessive amount of volatile organic material will remain in the black liquor as a consequence of the proposed reuse of condensates remains to be answered.

One result of too high a build-up of volatile organic materials would be difficulties due to foaming. Foaming tendencies in condensates used for pulp washing has in some cases interfered seriously with the operation of the common vacuum drum type washers. Excessive foaming could also prevent the successful operation of black liquor evaporators. Entrainment in the overhead from evaporators due to foaming is a serious problem when it occurs.

The practicality of the closed system as proposed lies in the hope that excessive build-up of materials will not occur and that such problems as do arise can be successfully controlled. The system presents an opportunity for the withdrawal of volatile organic materials by their inclusion in the cake going to the lime kiln. An increase in volatile organics carried with the black liquor to the recovery furnace without serious trouble is also a possibility. Proper selection of the condensate reused for pulp washing may reduce or eliminate interference with the washing process as the system outlined does not call for a large proportion of the wash water to be reused condensate. The proposed reuse system calls for the use of a small portion of evaporator condensate for pulp washing. This condensate would be used ahead of the fresh water on the pulp washers so that it would be washed from the pulp mat by the fresh water and become part of the weak black liquor. If the type of pulp washing system and amount of fresh wash water suggested is not sufficient to purge the reused condensate from the pulp mat some soluble organics may be carried out with the pulp mat. Undoubtedly these would be dissolved, to a large extent at least, in the wastes from the pulp screening and paper making operation. Any transfer of matter from one waste to another would detract from the accomplishments of reuse. If contamination of the washed pulp mat is so great that the contaminant is carried over into the paper serious repercussions could arise. Appreciable odor associated with paper used for packaging would be objectionable. Contamination of pulp used for bleaching likewise could be troublesome. If the washing received in pulp screening and paper making operations is not sufficient to take care of any contamination a further washing stage beyond the closed system might be added. The wash water from this stage would be wasted. This might permit reuse of condensate and result in a much reduced waste load over a system not reusing condensates.

The reuse of condensates containing volatile organic material for dissolving smelt could conceivably involve risks of explosion. However, the reuse outlined provides for aeration of the condensates used for dissolving the smelt by their prior use for washing the lime kiln stack gases; this may eliminate explosion possibilities. The present practice at some mills of reuse of condensate from the evaporators for dissolving smelt is evidence that such reuse is feasible.

Another possible objection to reuse is that the contaminants in the condensates may interfere with the chemical reactions and physical phenomena involved in treating the green liquor with lime and settling of the lime mud. Again the fact that some mills are reusing condensates for dissolving smelt indicates that no serious interference occurs.

It may be necessary to treat the condensates by some means prior to their reuse or to drawoff and treat a portion of the condensate in the recirculation system. Steam stripping of the condensates may remove considerable of the objectionable materials. Stripping with hot gases from the stacks of the lime kiln or furnaces may be of value for condensate treatment for reuse (3). The recovery of the constituent of value may be possible in the treatment system. Formic acid, acetic acid, lactic acid, dimethyl sulfide, methyl sulfide, methyl mercaptan, ketones, and guaiacol type phenolic compounds are some of the materials present.

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